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A SURVEY OF  
GEOMAGNETIC MICROPULSATION RESEARCH  
CONDUCTED IN CONNECTION WITH THE  
CO-OPERATIVE GEOMAGNETIC MICROPULSATION  
MEASUREMENT PROGRAM

Report No. 130

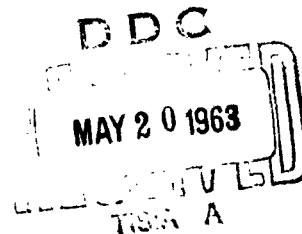
15 May 1963

Compiled by  
H. W. Smith  
Electrical Engineering Research Laboratory  
The University of Texas

under

Contract Nonr 375(14)  
NR 371-032

OFFICE OF NAVAL RESEARCH  
Washington, D. C.



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## ABSTRACT

At a conference on geomagnetic micropulsations held at the University of California on August 12-14, 1962 a committee was formed from representatives of the several research groups in attendance to conduct a survey to determine the desirability of a co-operative measurement program. The favorable response from this survey resulted in the formation of the Co-Operative Geomagnetic Micropulsation Measurement Program. This report contains a condensed summary of a survey form mailed to all research groups in the United States and Canada known to have an interest in geomagnetic micropulsations.

## I. INTRODUCTION

In the years following the IGY there has been a very rapid increase in both interest and research activity in geomagnetic micropulsations and related phenomena. Although no concise definition of the term micropulsation is generally recognized, most investigators will agree that the frequency range from about 0.001 to 5.0 cps includes most of the signals of interest. In this frequency range there is, thus, some overlap between the micropulsation measurements and the normal and rapid-run magnetograms that have been well standardized and widely recorded by geomagnetic observatories for many years.

Within the past few years a number of investigators have voiced a growing need for a more complete geographical coverage of micropulsation and earth current measurements, as well as a desire for suitable standards for equipment, bandwidths, and calibration procedures. For these reasons a number of research activities represented at a conference on Geomagnetic Micropulsations held at the University of California on August 12-14, 1962 decided to take positive steps toward a co-operative program designed to help satisfy some of these needs.

As a first step, a co-ordinating committee for what has become known as the Co-operative Geomagnetic Micropulsation Measurement Program (CGMMP) was selected. This committee was initially charged with the task of conducting a survey to determine the interest and willingness of research

activities to participate in such a program. If the survey showed an insufficient interest on the part of the research groups, the whole program would be abandoned without further effort. It was decided that a favorable response would warrant the establishment by this committee of recording schedules, the gathering and distribution of selected data, the study of equipment and standards, and a variety of other activities associated with the program.

Members of this co-ordinating committee are as follows:

H. W. Smith - The University of Texas - Chairman  
A. K. Harris - S. R. D. L. - Fort Monmouth  
J. R. Heirtzler - Lamont Geological Observatory  
V. P. Hessler - Geophysical Institute - University of Alaska  
S. H. Ward - University of California

It is the purpose of this brief report to summarize the results of a survey form mailed to all research groups in the United States and Canada known to have an interest in geomagnetic micropulsation phenomena.

## II. SURVEY RETURNS

A copy of the original survey form is shown in Appendix A. In addition to questions relating to equipment, test sites, timing, etc., entries were requested regarding special interest, data processing facilities, willingness to participate in a joint measurement program, and comments and suggestions.

From these original returns a condensed form, mostly relating to equipment and measurements, was compiled. These condensed forms are

shown in Appendix B. A total of 30 research groups listing approximately 60 fixed or mobile sites are included in this summary. In addition a number of investigators involved in theoretical studies or in related fields expressed a desire to receive copies of data and results obtained from the program.

### III. SURVEY RESULTS

A study of the original returns and accompanying letters, publications, and reports provides the basis for the following observations and conclusions:

1. Perhaps the most significant result of the survey is the fact that an overwhelming majority of the replies were in favor of the program and promised co-operation in varying degrees ranging from 100% to occasional participation if it did not interfere with other commitments. The most frequent reply was to the effect that co-operation would be to the fullest extent that facilities and prior commitments would permit.

2. The survey revealed, as expected, a wide diversity in equipment and recording techniques. There is no question but that this diversity constitutes a major difficulty in the exchange of data. A sub-committee is currently studying this problem, but since so much of the equipment is already in existence, attempts to standardize in the early stages of the program will have to be on a minor scale. This problem is really international in scope and is currently under study by Committee No. 10 of IAGA. It was mentioned more than anything else in the comments and suggestions entry on the survey.

3. Partly as a consequence of the equipment and operating diversity mentioned in item 2, the original survey form was not entirely appropriate as is often the case. Thus, the amount of detail in the descriptions of equipment and recording techniques varied from meager to most elaborate, requiring numerous footnotes and explanations. Some caution is, therefore, appropriate in using the condensed forms as they were difficult to compile, and there are no doubt important omissions and inaccuracies. Questions on specific details should be directed to the individual investigators.

4. No claim is made that this survey represents all of the research currently being conducted in this area. On the contrary, the committee is well aware of highly significant programs operated by other groups and individuals. In general, these programs have specific experiments in progress and the data are not generally available to a group as large as the CGMMP. Notable in this regard are the networks of stations operated by Benioff, Campbell, Maple and others.

5. It should not be expected that every research group will participate in every simultaneous recording period. Hopefully, a reasonable percentage will be in operation on any given test.

6. The geographic distribution of stations is evident in the condensed forms, but may be summarized as follows: The largest concentration of stations is in the U.S.-northeast-Canadian-southeast, or along the 70th meridian. There is a secondary grouping along the west coast of North America. Some coverage in the Pacific, Puerto Rico, New Zealand

and Japan is anticipated. Certain European stations, particularly the French who also operate in South Africa, have expressed a willingness to co-operate on specific occasions. Notable gaps exist in the lower latitudes and in the mid-continent area. As mentioned in item 5, however, the actual coverage may vary considerably. In any event the network is potentially larger than any yet attempted.

**APPENDIX A**  
**Geomagnetic Micropulsation Survey Form**

## GEOMAGNETIC MICROPULSATION SURVEY

### I. Signal Components Normally Recorded: (Use code below)

Code	
$H_t$	Total Magnetic
$H_x$	North Magnetic
$H_y$	East Magnetic
$H_z$	Vertical Magnetic
$E_x$	North Electric
$E_y$	East Electric
$E_z$	Vertical Electric
Other	Please specify

Signal Component	Bandwidths	Basic Instrument (Magnetometer, coils, etc.)	Normal Full Scale Sensitivity	Approx. % of time recording

**II. Recording Sites:**

Site	Signals Recorded	Status - past, present, future

**III. Recording Equipment:**

(Please describe briefly the type of recording equipment available including normal chart or tape speeds)

**IV. Primary Interest or Specialization:**

(Briefly indicate any special interest in the field of micropulsations, i.e., magnetotellurics, pearls, Schumann resonances, etc.)

**V. Timing:**

(Please describe basic timing device with an estimate of timing accuracy)

**VI. Computing and Data Processing Facilities:**

(Please describe briefly, including data processing facilities)

**VII. Background Noise Level:**

(Please describe any unusual noise problems at measuring sites)

**VIII. Please indicate the extent you would be willing to cooperate in a joint measurement program at selected times.****IX. To what extent would you be able or willing to make available copies of selected data to others in a joint measurement program?****X. Equipment**

(Please reference reports or publications which describe your equipment. If you have a brief equipment write-up, please include a copy.)

**XI. Comments and Suggestions:**

## APPENDIX B

<u>Research Group:</u>		<u>Reported by:</u>		<u>Special Interests:</u>		
Ionospheric Physics Lab. GRD - AFCRL Bedford, Mass.		Elwood Maple				
Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % Time
Strawberry Hill, Mass.	H <sup>x</sup>	Coils	0.005-4 cps	Variable	±1 sec. or better	Continuous for selected intervals of several days or more each - since June 1962.
	H <sup>y</sup>	"	"	"	"	
	H <sup>z</sup>	"	"	"	"	
	H <sup>x</sup>	"	"	Reserve-low sensitivity channels	"	
	H <sup>y</sup>	"	"	variable	"	
Pt. Barrow, Alaska*	H <sup>x</sup>	Coil	1-50 cps			To start operation in 1963.

Notes and References:

\* Equipment similar to Strawberry Hill to be furnished by AFCRL. Station to be operated by Dr. V. P. Hessler, Univ. of Alaska.  
Recording on 7-channel, 1/2 in. tape, 0.1 or 0.05 ips. Also visual playback.



Research Group:		Reported by:		Special Interests:		
Geophysical Institute University of Alaska College, Alaska (continued)		V. P. Hessler		(Listed on preceding page)		
Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % Time
College	E <sub>x</sub>	Earth probes- potentiometer- EA micropulsation recorder	.05-.33 cps	400 mv/km	3"/hr. *	100% since Nov. 1962
College	E <sub>x</sub>	Earth probes- potentiometer- EA micropulsation recorder and special trace on loop of chart paper	.1-1 cps	125 mc/km	3/4" * min	100% since Nov. 1961
College	E <sub>x</sub>		5-20 cps		30" * min	Under development
College	H <sub>t</sub> H <sub>t</sub>	Rb. vapor magnetometer Helium vapor magnetometer	variable	variable		Under development
Barrow	H <sub>x</sub> H <sub>y</sub> H <sub>z</sub>	Coil systems and tape recording	.01-3 cps	2 channels on each 80 db range		100% will go into operation about March 1, 1963

Notes and References:

\* Chart speeds

<u>Research Group:</u>		<u>Reported by:</u>		<u>Special Interests:</u>		
University of Alberta Edmonton, Alberta, Canada		K. Vozoff		Magnetotellurics and pulsation structure		
Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % Time
Leduc, Alberta, Canada	H <sub>x</sub> H <sub>y</sub> H <sub>z</sub>	Iron Core Coils	2 millicps- " 10 cps " "	0.01 - 10 γ " " " "	± 50 milli- sec	1%
	• E <sub>x</sub> E <sub>y</sub>	Copper rod electrode	2 millicps- " 8 cps " "	1 mv/km " "		
<u>Notes and References:</u>						

Research Group:		Reported by:		Special Interests:	
Institute of Earth Sciences The University of British Columbia Vancouver 8, Canada		J. A. Jacobs		Micropulsation in the frequency range 0.2 - 10 cps - (pearls).	

Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % Time
Westham, island approx. 20 miles south of Vancouver	H <sub>x</sub> <sup>x</sup>	Iron core coils	0.01 - 5 cps and 0.3 - 3 cps " 0.01 - 5 cps " "	5 γ	1 sec	H <sub>x</sub> <sup>y</sup> 80 %
	H <sub>y</sub> <sup>y</sup>			.5 γ		H <sub>z</sub> 20 %
	H <sub>z</sub> <sup>z</sup>					
	H <sub>x</sub> <sup>x</sup>			5 γ		At present
	H <sub>y</sub> <sup>y</sup>			5 γ		0 %
				5 γ		

Notes and References:

- English, W. N., D. J. Evans, J. E. Løkken, J. A. Shand and C. S. Wright, Equipment for observation of the natural electromagnetic background in the frequency range 0.01-30 cps., Pacific Naval Laboratory reprint 61-3.
- Shand, J. A., Proceedings of the meeting to discuss the cooperative low frequency electromagnetic measurement program of 1960, Pacific Naval Laboratory Note 60-42. Appendices C and D.

Research Group:

Department of Mineral Technology  
University of California  
Berkeley, California

Reported by:

S. H. Ward

Special Interests:

Tellurics - Structural studies  
Dynamics of the Magnetosphere

Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % Time
Briones Valley, California	$H_t$ $H_{hor}$	$R_b$ magnetometer "	.0001-1 cps "	2γ "	±1 sec	25% "
Sacramento, California	$H_t$ $H_{hor}$ $E_x^*$ $E_y$	$R_b$ magnetometer "	0.001-1 cps " " "	2γ " 10 mv "		25% " " "

Notes and References:

Report in Process



<u>Research Group:</u> Research Department General Dynamics/Electronics 1400 N. Goodman Street Rochester, N. Y.		<u>Reported by:</u> Raymond A. Santirocco		<u>Special Interests:</u> $H_x, H_y, H_z$ at sea from 0.01-1 cps  Understanding signal sources and propagation phenomena.	
<u>Recording Site</u>  Hathaway Hill, Penfield, N. Y.	<u>Signal Component</u>  $H_x$ $H_y$ $H_z$	<u>Basic Instrument</u>  Mumetal coils	<u>Bandwidth</u>  0.001-3 cps	<u>Full Scale Sensitivity</u>  $2 \times 10^{-2} \gamma/\text{sec}$ " " " "	<u>Timing Accuracy</u>  Slow speed $\pm 10 - 15 \text{ sec}$ Tape records $\pm (1 - 10) \text{ mill sec}$
Beneway Farm Ontario, N. Y.	$H_x$	Aircore loop	20-15,000 cps		3%
<u>Notes and References:</u> A report will be issued shortly.					

<u>Research Group:</u> HRB-Singer, Inc. Research Department State College, Pa.		<u>Reported by:</u> C. F. Sechrist, Jr.		<u>Special Interests:</u> Correlation of geomagnetic micropulsations with VLF phase perturbations during periods of high micropulsation activity and magnetic storms. Spectrograms of geo-magnetic and VLF phase fluctuation.		
<u>Recording Site</u> State College, Pennsylvania 49°49' N 77°53' W geographic coordinates	<u>Signal Component</u> H <sub>x</sub>	<u>Basic Instrument</u> Iron core coil	<u>Bandwidth</u> 0.001-5 cps	<u>Full Scale Sensitivity</u> 100 γ at 0.001 cps 1 γ at 5 cps 70 γ at 5 cps	<u>Timing Accuracy</u> fraction of 1 sec	<u>Recording Status and % Time</u> 100%
<u>Notes and References:</u> Report in process						

<u>Research Group:</u> High Altitude Observatory Boulder, Colorado		<u>Reported by:</u> S. Matsushita		<u>Special Interests:</u> Micropulsations associated with known geomagnetic phenomena, such as SC, SL, bay, flare, P <sub>c</sub> and so on.	
Recording Site  High Altitude Observatory Radio Astronomy Laboratory 3 miles north of Boulder.	Signal Component  H <sub>t</sub>	Basic Instrument  R <sub>b</sub> Vapor magnetometer	Bandwidth  to 1 cps	Full Scale Sensitivity  6.6 γ per 100 divisions approx. 0.060 γ	Timing Accuracy  synchronance clock driven from power line, checked once every 24 hours with WWV
					Recording Status and % Time  100% since Jan. 1962
<u>Notes and References:</u> Noise level "no problem."					

Research Group:

Hughes Aircraft Co.  
Communications Division  
Los Angeles 9, Calif.

Reported by:

S. W. Lichtman

Special Interests:

Magnetotellurics directed towards propagation,  
detection and communication phenomena.

Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % Time
Culver City	$E_x$ $E_y$	lead electrodes	0-100 kc "	0.7-40 mv/km "	.01 sec	Capable of 100%

Notes and References:

A report is available.





<u>Research Group:</u>		<u>Reported by:</u>		<u>Special Interests:</u>		
Lockheed Aircraft Physical Sciences Lab. Palo Alto, Cal.		Lee R. Tepley		Pearls		
Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % Time
Palo Alto, Cal.	H <sub>t</sub>	Proton Mag.	0-1/60 cps	100 γ		100% since
	H <sub>x</sub>	Air Core Loop	0.3-7 cps	0.0003 γ*	0.1 sec	Feb 61 through 63.
	E <sub>z</sub>	Vertical Antenna	5-50 cps	50 μv/m*		
Hawaii, Tonga-Tapu (Tonga Islands)	H <sub>x</sub>	Iron Core Loop	0.3-7 cps	0.001 γ*		May-Aug, 62, 100%
	E <sub>x</sub>	Earth Current	0.3-50 cps	20 μv/km*	0.1 sec	Sept 62 - Jan 63
	E <sub>y</sub>	" "	" "	" "		100%
Canton Island	H <sub>x</sub>	Iron Core Loop	0.3-7 cps	0.001 γ*	0.1 sec	Sept 63 to present
	H <sub>y</sub>	" "	0.3-7 cps	0.001 γ*		100%

Notes and References:

\* Instrument Noise Levels

"Structure and Attenuation of Hydromagnetic Emissions," Vol. I and II, Lee R. Tepley and R. C. Wentworth, Lockheed Missiles and Space Co., Scientific Report No. 1, 6 April 1962.

Research Group:		Reported by:		Special Interests:		
Massachusetts Institute of Technology Cambridge, Massachusetts		T. Cantwell and T. Madden		Magnetotellurics, pearls, Schumann resonances, and other interesting geomagnetic phenomena.		
Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % Time
Mobile sites in Mass., N. H., Maine	E <sup>x</sup> E <sup>y</sup> H <sup>x</sup> H <sup>y</sup>	Horizontal grounded antenna μ metal coils	0.005-2 cps and 0.05-50 cps "	5 my/cps		Mobile station only at present time.
Fixed Site to be set up 20 miles west of Boston	E <sup>x</sup> E <sup>y</sup>					
<u>Notes and References:</u> T. Cantwell PhD Thesis and letter in J.G.R.						



<u>Research Group:</u> National Aeronautics and Space Administration Ames Research Center Moffett Field, California		<u>Reported by:</u> Darrell D. McKibbin		<u>Special Interests:</u> Earth-Solar Magnetic Fields	
Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy
	H <sub>t</sub>	Stationary Search Coils Fluxgate He-Magnetometer	0-50 cps	1-100 γ	
Recording Status and % Time					
<u>Notes and References:</u>					



Research Group:

Advanced Systems Analysis

Space and Information Systems Div.

North American Aviation, Inc.

Downey, California

Reported By:

R. A. Fowler

Special Interests:

Magneto-tellurics from nuclear blast and missile firing as well as from solar terrestrial interaction.

Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % Time
Santa Susana Mountains Chatsworth, California	$E_x$ $E_y$	1000 ft. apart ground probes	0-40 cps 30 cps- 30 Kc 100 cps- 1 Kc 200 cps- 2.5 Kc	.4-500 $\frac{\text{volts}}{\text{micro meter}}$	1 millsec.	Only during nuclear tests.
	$H_x$ $H_y$ $H_z$	air core loop	0-40 cps 30 cps- 30 Kc 100 cps- 1 Kc 200 cps- 2.5 Kc	0.001 $\gamma$ 0.001 $\gamma$ 0.001 $\gamma$		

Notes and References:

Magneto-Teleric Data Collection and Data Handling Capabilities

North American Aviation Inc.



<u>Research Group:</u> University of Puerto Rico Mayaguez, P. R.		<u>Reported by:</u> Prof. Braulio Dueno		<u>Special Interests:</u> Relationship between geomagnetic micro-pulsations and ionosphere, radio-star ionospheric drift experiment.	
Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy
Mayaguez, P. R.	$H_t$	Rb. Vapor Magnetometer	3 kc	20 $\gamma$	6 in/hr * 6 in/min
					Recording Status and % Time
					100%
<u>Notes and References:</u> * Chart speeds					

<u>Research Group:</u>		<u>Reported by:</u>		<u>Special Interests:</u>		
Dept. of Electrical Engineering University of Rhode Island Kingston, R. I.		C. Polk		Schumann resonances and related phenomena.		
Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % Time
Kingston, R. I. lat. 41° 29' 45" Long. 71° 31' 37"	H <sub>x</sub> H <sub>y</sub>	Iron Core Coils*	50-20 cps	2 x 10 <sup>-5</sup> amp/m	Ordinary mechanical clock ± 1 sec Checked by NBA	Sample one minute every ten minutes 24 hrs/day

Notes and References:

\* Extremely low frequency reception at Kingston, Rhode Island  
C. Polk and F. Fitchen, Scientific Report No. 1  
Journal of Research of the NBS, Vol. 66D, No. 3, May-June 1962, p. 313-318



**Special Interests:**

**Electrical Engineering Research  
Laboratory  
The University of Texas  
Austin, Texas**

H. W. Smith  
F. X. Bostick

**Magnetotellurics, coherence of component signals over large distances.**

Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % Time
Austin, Texas Fixed station	H <sub>x</sub> H <sub>y</sub> H <sub>z</sub> E <sub>x</sub> E <sub>y</sub>	Air Core Coils  Ground probes	0.002-2 cps  0.005-2 cps	1 $\gamma$  1 mv/km	.01 sec	100%
Mobile station	H <sub>x</sub> H <sub>y</sub> H <sub>z</sub> E <sub>x</sub> E <sub>y</sub>	Iron Core Coils  Ground Probes	0.002-10 cps  0.005-10 cps	1 $\gamma$  250 $\mu$ v/km	.01 sec	Variable at different sites
Past Mobile Sites Grand Bahama Is. Puerto Rico	Oct. 1961 June	- Jan. 1962 - Oct. 1962				

## Notes and References:

EERL Report Nos. 111, 112, 113, 115, 116, 118, 119, 120, 123, 126, 127, 128

**J. G. R. March 1961**

**Special Interests:**

L. R. Alldredge

**General interest in all phases including short period fluctuations.**

Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % Time
Fredericksburg, Va.	#	Magnetograph using suspended or balanced permanent magnets	dc - 0.2 cps	2 to 5 gammas/mm of ordinate	*	100% at all except Eights Station, Antarctic which is currently being installed.
Tucson, Ariz.	H <sub>h</sub>					
Barrow, Alaska	H <sub>d</sub>		dc - 0.2 cps			
College, Alaska						
Sitka, Alaska						
Honolulu	H <sub>z</sub>		dc - 0.1 cps			
Guam						
Byrd Sta., Antarc.						
Eights Sta., "						

## Notes and References:

## # Conventional geomagnetic terminology

**\* Sufficient and consistent with chart speeds**

**Research Group:** U. S. Geological Survey  
Theoretical Geophysics Branch  
Denver, Colorado

**Reported by:** George V. Keller

**Special Interests:** Magnetotelluric Field - resistivity determination

Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % Time
Bergen Park Observatory (35 miles west of Denver, Colo.	$E_x$ $E_y$ $H_t$ $H_x$ $H_y$	Earth probes " " Helium-Vap. Mag. Air Core Coils <sup>1</sup> " " " "	Not Specified	Not Specified	Crystal-controlled electronic clock - WWV to 10 m sec at best	Schedule not given. Recording on May tape at 0.3 ips and 4 channel visual monitor at chart speed 1 cm/min
Hawaiian Volcano Obs. (30 miles S. of Hilo, Hawaii)	$E_x$ $E_y$ $H_z$	Earth probes " " Air core coil <sup>2</sup>	Not Specified	Not Specified	Mechanical chronometer ref - WWV once daily	Schedule not given. Normal recording - 4-channel charts at 1.5 cm/min. Speeds to 600 cm/min.
Mobile Magnetotelluric Obs.	$E_x$ $E_y$ $H_t$ $H_x$ $H_y$ $H_z$	Earth probes " " Rb. - Vap. Mag <sup>3</sup> " " " " " " Air core coil <sup>4</sup>	Not Specified	Not Specified	xtal-cont. WWV-Rec.	Schedule not given. Recording on mag tape at 0.3 ips and 4-channel recorder - 1.5 cm/min to 600 cm/min chart speeds

**Notes and References:**

1. Effective area - 64,000 sq. meters
2. 25 x 10<sup>6</sup> sq. meter coil to be added before end of 1962
3. Magnetometer modified to record total field or a component or components sequentially
4. Effective Area - 52,000 sq. meters

Research Group:U. S. Geological Survey  
(cont'd)Reported by:

George V. Keller

Special Interests:

Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % Time
Mobile Earth Current Systems (3 systems)	E <sup>x</sup> E <sup>y</sup> H <sup>x</sup> <sub>5</sub> H <sup>x</sup> <sub>5</sub> H <sup>y</sup> <sub>6</sub> H <sup>z</sup>	Earth probes " " Air core coils " " " " " "	Not specified	Not specified	xtal-cont. WWV-Rec.	Schedule not given. Recording on 4-channel recorder with speeds 1.5 cm/min to 600 cm/min Also 7-channel recorder with speeds 3.6 cm/min to 3600 cm/min.

Notes and References:

5. Effective area - 64,000 sq. meters
6. Effective area - 52,000 sq. meters

**Research Group:**

U. S. Naval Air Development  
Center  
Johnsville, Pa.

**Reported by:**

D. P. Miles

**Special Interests:**

Observation of magnetic storms, micropulsations  
and related earth current effects relative to  
magnetic anomaly detection equipment.

Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % Time
U. S. Naval Air Dev. Cent. Johnsville, Pa.  Lat. 40°12' N. Long. 75°04' W.	H <sub>t</sub> H <sub>t</sub> H <sub>t</sub> H <sub>v</sub> E <sub>x</sub> E <sub>y</sub>	Proton Prec. Mag. Rb. Vap. Mag. Rb. Vap. Mag. Coils	1 reading/min 0 - 1/4 cps 0.07 - 0.7 cps	70 γ 6.7 γ*	at 6"/hr ±15 sec. - at 2"/min ±1 sec.  Future " "	75% past, present, future  75% "

**Notes and References:**

\* 2 γ full scale during special events

Recording on paper charts with mag. tape to be installed.

U. S. Naval Air Development Center Reports No. NADC-AW-6226 and 6249.

Research Group:

Reported by:

Special Interests:

U. S. Naval Oceanographic Office  
Marine Sciences Department  
Washington 25, D. C.

R. H. Randall, Jr.

Recording  
Site

Wallops Is.,  
Virginia

Signal  
Component

Basic  
Instrument

Bandwidth

Full Scale  
Sensitivity

Timing  
Accuracy

Recording Status  
and % Time

Not yet operational

Notes and References:

<u>Research Group:</u> Instrument Division Varian Associates 611 Hansen Way Palo Alto, Calif.		<u>Reported by:</u> Breiner		<u>Special Interests:</u> Providing magnetometers to record at all frequencies. Gradiometer configurations, cancelling out micropulsation activity over distance of a few feet to a few miles.	
Recording Site  Site 501 Stanford University  Varian Associates Palo Alto, Cal	Signal Component  $H_t$	Basic Instrument  $R_b$ Vapor magnetometer	Bandwidth  0.001-3 cps	Full Scale Sensitivity  20γ	Timing Accuracy  ±1 sec
				Recording Status and % Time  80%	
<u>Notes and References:</u> Varian Associates Rubidium Vapor Station Magnetometer X-4936 Data Sheet					

**Research Group:**

Victoria Magnetic Observatory  
Royal Oak, B.C., Canada

Reported By:

**B. Caner**

**Special Interests:**

Accurate timing of magnetohydrodynamic phenomena. Statistical processing of geomagnetic data obtained under rigidly controlled conditions (i.e. stable and well defined sensitivity, wide-band linear frequency response etc.)

Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % time
Victoria Magnetic Observatory	<u>Magnetic Field</u> Declination Horizontal	Three component flux-gate. <sup>2</sup> (Saturable core)	0.1-1 cps	10γ, 20γ	Slow recording ± 5 sec on hour mark	Declination-intermittent 100% by 1963
Geographic Coordinates	H <sub>z</sub>	Modified for increased sensitivity		10γ, 20γ	Fast recording ± 0.1 - ± 0.2 sec.	Horizontal and H <sub>z</sub> not operational until 1963
48° 31' N - 123° 35' W						

### **Notes and References:**

### \*Reference

1. Caner and Whitham, Can. J. Physics, 1962, Vol. 40 No. 12
2. Serson, Can. J. Physics, 1957, 35, 1387.

Research Group:		Reported by:		Special Interests:		
Department of Geophysics Weston Observatory Weston 93, Mass.		Daniel Linehan, S. J.		Absolute calibration of magnetic instruments		
Recording Site	Signal Component	Basic Instrument	Bandwidth	Full Scale Sensitivity	Timing Accuracy	Recording Status and % Time
Weston Observatory, Weston	H <sub>t</sub>	R <sub>b</sub> Vapor magnetometer	0 - 0.2 cps	20 γ		100%
	H <sub>z</sub>	Proton precession magnetometer	0 - 0.02 cps	2000 γ		
	H <sub>H</sub>	"	"	2000 γ		
	Declination	"	"	2000 γ		
	E <sub>x</sub>		0 - 1 cps	100 mv/500 ft		100% experimental
	E <sub>y</sub>		"	200 mv/2K ft		
	E <sub>y</sub>		"	100 mv/500 ft		
Notes and References: Transactions of AGU, Sept. 1961. Weston Magnetic Facility, R. O. Hutchinson, J. Pomeroy, S. J.						

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